

# Artificial Intelligence (AI)

Oguzhan (Ouz) Gencoglu

Tampere University of Technology  
Top Data Science

Turku Turbulence - 8 November 2016

What Exactly Is AI/Machine Learning?  
What Can Possibly Happen?  
But, How Do These Work?  
What Can Be Done?  
Where Are We Heading?  
Conclusion

# Tampere University of Technology



TAMPERE  
UNIVERSITY OF  
TECHNOLOGY

What Exactly Is AI/Machine Learning?  
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# Top Data Science



A Top Data Science Company

# Outline

## 1 What Exactly Is AI/Machine Learning?

- Some Terminology
- Quick History
- Recent Highlights

## 2 What Can Possibly Happen?

- Theories, Possibilities, Claims & Loads of Bullsh\*t
- Some Thoughts

## 3 But, How Do These Work?

- Teach Me Master
- There Is No Free Lunch!
- 2-minute Science
- Consequences

## 4 What Can Be Done?

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# Some Terminology

Data Science

Attempt to make sense out of data

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Attempt to make sense out of data

## Machine Learning (ML)

Subfield of *computer science*, algorithms that can learn without being explicitly programmed

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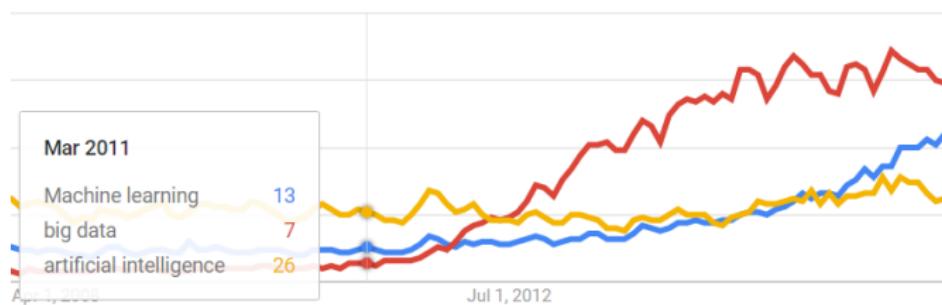
## Machine Learning (ML)

Subfield of *computer science*, algorithms that can learn without being explicitly programmed

## Artificial Intelligence (AI)

Machines mimicking *cognitive* functions of humans

# Some Terminology



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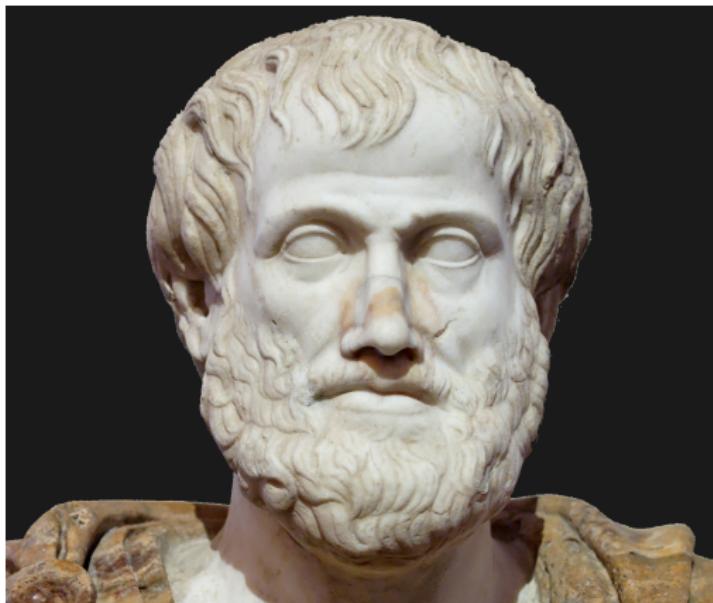
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# Quick History



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# Quick History



# Quick History

- Ancient Greek: Aristotle, first formal deductive reasoning system

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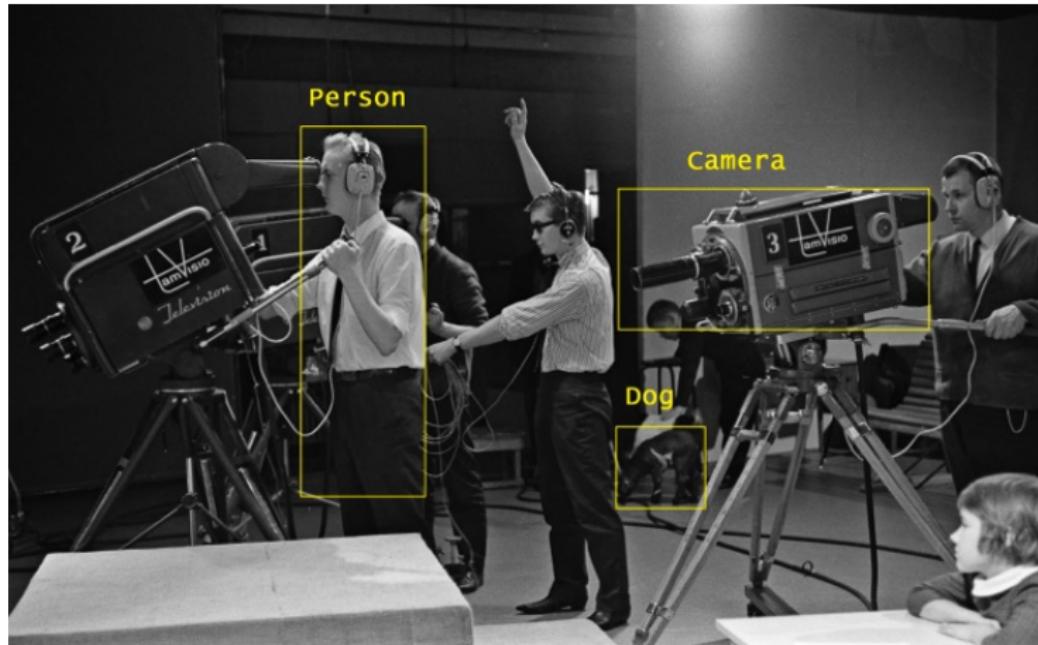
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# Generic Object Recognition



# People Count



# Age & Gender Estimation



# Person Identification



© PA

# Visual Description



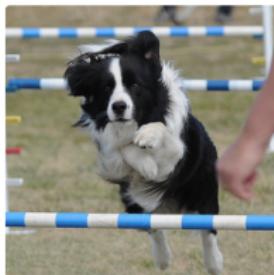
"man in black shirt is playing guitar."



"construction worker in orange safety vest is working on road."



"girl in pink dress is jumping in air"



"black and white dog jumps over bar"

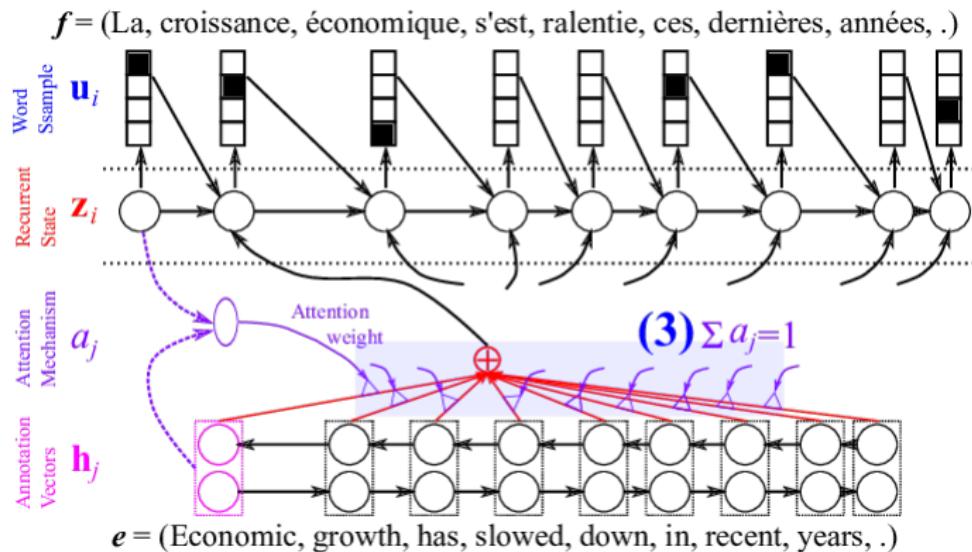
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# Style Transfer



# Machine Translation



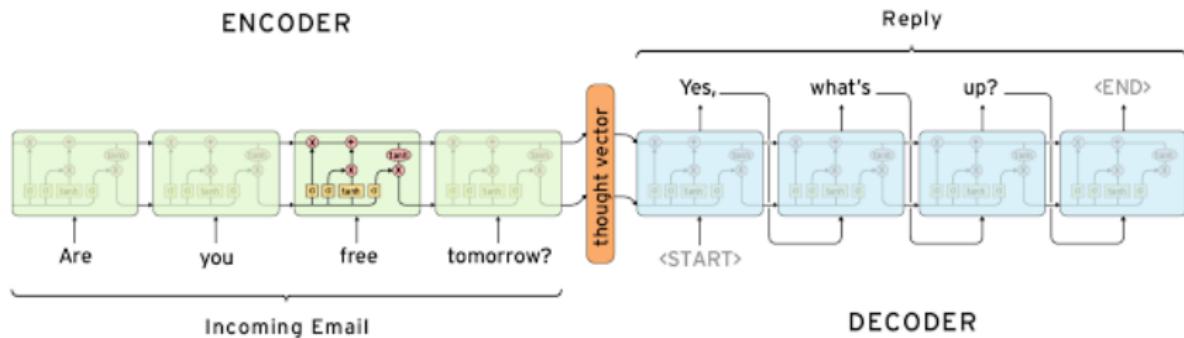
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# AI in Games



# Chatbots



DeepDrumpf  
@DeepDrumpf



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OK, it's amazing right now with ISIS, I tell you what? I don't want them to vote, the worst very social people. I love me.



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# Image Super-resolution



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# Image Generation



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# Assessing Actions

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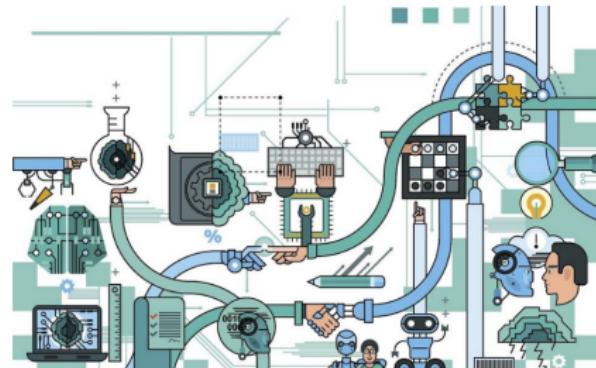
# Predicting Actions

# Topic Classification



TIETOJENKÄSITTELY | Tapio Ikkala | 23.8. klo 11:34

**Koneoppimiskilpailun finalistit  
Tampereelta - Yhden miehen tiimi haastaa  
IBM:n Watsonin**



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# Clinical Decision Support



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# Self-driving Vehicles



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# Other Examples

- Speech Recognition

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- Speech Recognition
- Automated Workforce

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- De-anonymization, Fraud Detection, Criminal Identification

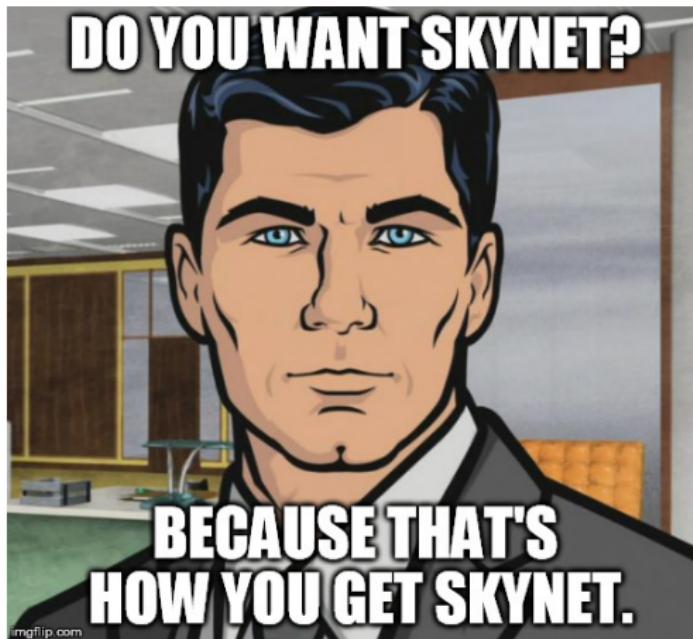
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Theories, Possibilities, Claims & Loads of Bullsh\*t  
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# What Can Possibly Happen?



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# Theories, Possibilities, Claims & Loads of Bullsh\*t

## Claim

- Superintelligence by 2100 is inevitable!
- Superintelligence by 2100 is impossible!

# Theories, Possibilities, Claims & Loads of Bullsh\*t

## Claim

- AI will turn evil!
- AI will turn conscious!

# Theories, Possibilities, Claims & Loads of Bullsh\*t

## Claim

- AI will turn evil!
- AI will turn conscious!

## Actual Worry

- AI becoming very competent with its own goals.

# Theories, Possibilities, Claims & Loads of Bullsh\*t

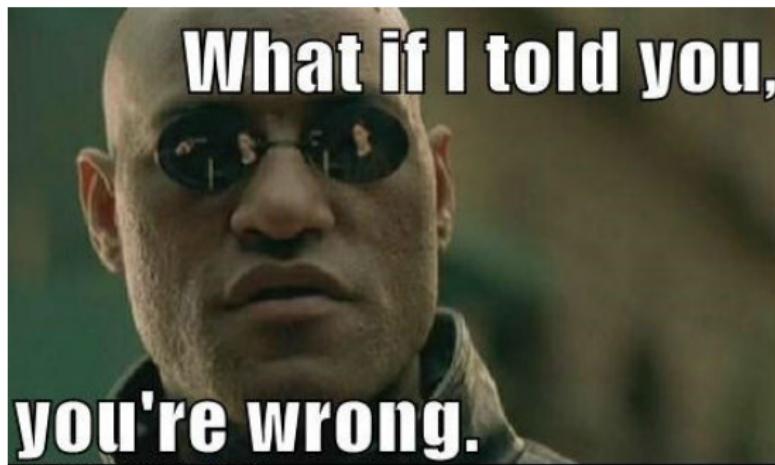
## Claim

- A creature can not acquire higher intelligence than its creator.

# Theories, Possibilities, Claims & Loads of Bullsh\*t

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# Theories, Possibilities, Claims & Loads of Bullsh\*t

## Claim

- Robots will replace labour. Low-paid work or unemployment seem to be the only possible options.

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**Everyone can enjoy a life of luxurious leisure if the machine-produced wealth is shared, or most people can end up miserably poor if the machine-owners successfully lobby against wealth redistribution. So far, the trend seems to be toward the second option, with technology driving ever-increasing inequality.**

*Stephen Hawking*

**An extremely intelligent future AI will probably develop a drive to survive and acquire more resources as a step toward accomplishing whatever goal it has, because surviving and having more resources will increase its chances of accomplishing that other goal.**

*Steve Omohundro*

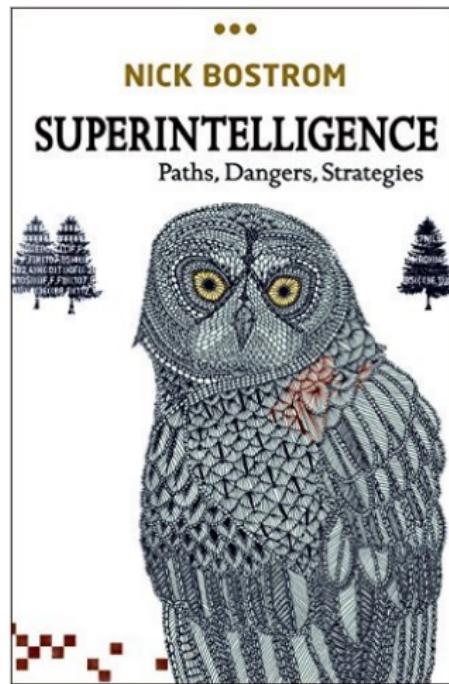
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**What level of sophistication will artificial intelligences need to attain before we consider that they deserve legal rights?**

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Rex Rizzo  
@RexRizzo

Follow

Wired: "Machine learning will TAKE OVER THE WORLD!"

Amazon: "We see you bought a wallet. Would you like to buy  
ANOTHER WALLET?"

9:25 PM - 28 Jul 2016



8,394



11,781

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# But, How Do These Work?

(Most) Machine learning algorithms learn from examples, i.e.,  
supervised learning.

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Accuracies tend to increase with more data.

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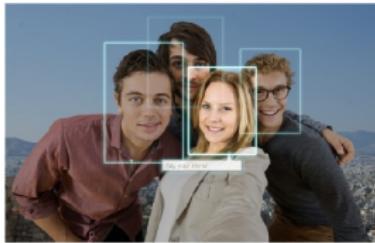
Accuracies tend to increase with more data.

**YOU ARE THE TEACHER!**

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# But, How Do These Work?



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Balls of Fury has been added to your DVI at position 454.

This movie is available.

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Demolition

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4.5 stars

Balls of Fury

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Mr. Woodcock

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# No Free Lunch Theorem

There is always a trade-off

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# No Free Lunch Theorem

There is always a trade-off

- Complexity **vs.** Interpretability & Transparency

# No Free Lunch Theorem

There is always a trade-off

- Complexity **vs.** Interpretability & Transparency
- Accuracy **vs.** Computation Power

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- Accuracy **vs.** Computation Power
- Specificity **vs.** Sensitivity

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- Accuracy **vs.** Computation Power
- Specificity **vs.** Sensitivity
- Bias **vs.** Variance

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# An Example

Certain patterns occur frequently in nature.

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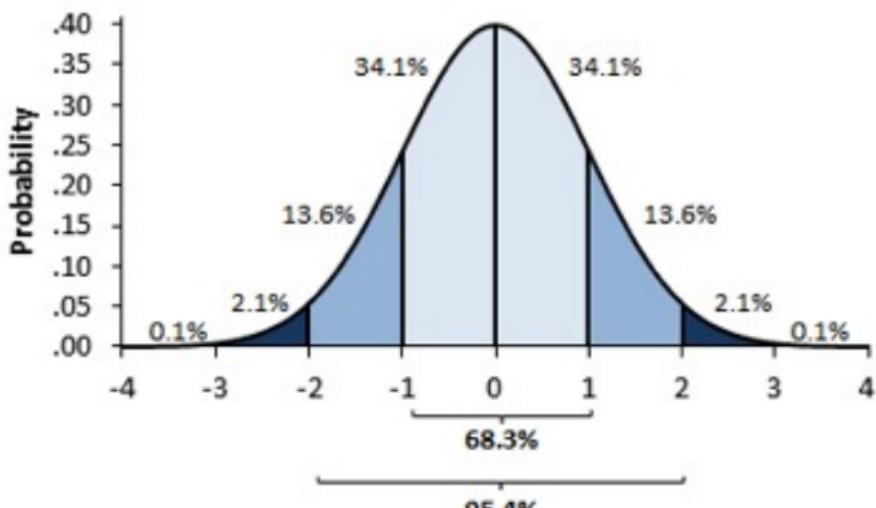
Certain patterns occur frequently in nature.

Normal (Gaussian) Distribution

# An Example

Certain patterns occur frequently in nature.

## Normal (Gaussian) Distribution



# Normal Distribution

## ■ Velocity of Molecules in a Gas

---

<sup>1</sup>Huxley, Julian S. (1932). Problems of Relative Growth.

<sup>2</sup>Oosterbaan, Roland J. (1994). "Chapter 6: Frequency and Regression Analysis of Hydrologic Data". In Ritzema, Henk P. Drainage Principles and Applications

<sup>3</sup>Andersen, Torben G., et al. (2001) "The distribution of realized stock return volatility." Journal of financial economics 61.1

# Normal Distribution

- Velocity of Molecules in a Gas
- Human Height<sup>1</sup>

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- Velocity of Molecules in a Gas
- Human Height<sup>1</sup>
- Monthly Rainfall<sup>2</sup>

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# Normal Distribution

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Why?  $\implies$  Central Limit Theorem

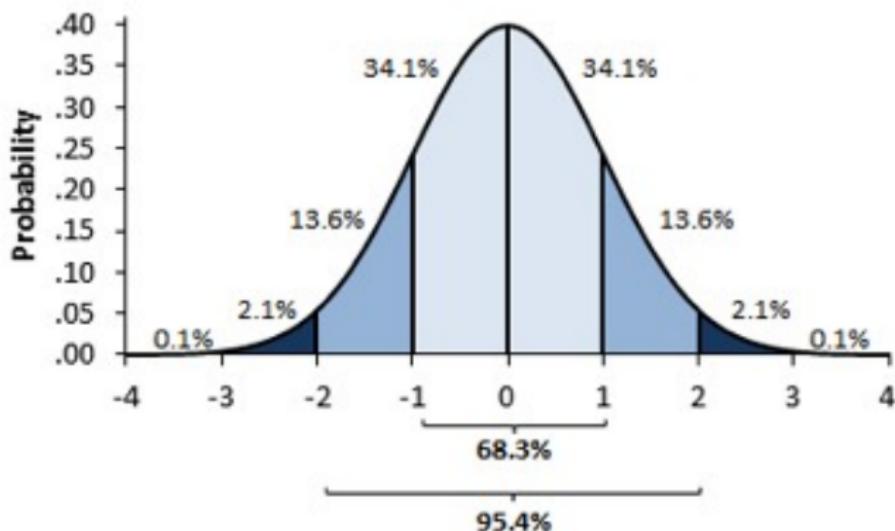
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## Inevitable Nature of Things



There will be outliers, anomalies and under-represented groups/subsets!

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## Consequences

# Supervised Algorithms

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## Consequences

# Supervised Algorithms + Biased Data

What Exactly Is AI/Machine Learning?  
What Can Possibly Happen?  
**But, How Do These Work?**  
    What Can Be Done?  
    Where Are We Heading?  
    Conclusion

Teach Me Master  
There Is No Free Lunch!  
2-minute Science  
**Consequences**

## Consequences

**Supervised Algorithms**  
+  
**Biased Data**  
=

**Biased Algorithms**

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# Ugly Results

If the training data reflect existing social biases against a minority, the algorithm is likely to incorporate these biases.

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<sup>4</sup><http://www.independent.co.uk/life-style/gadgets-and-tech/news/googles-algorithm-shows-prestigious-job-ads-to-men-but-not-to-women-10372166.html>

<sup>5</sup>[http://www.huffingtonpost.com/2015/04/10/google-image-gender-bias\\_n\\_7036414.html](http://www.huffingtonpost.com/2015/04/10/google-image-gender-bias_n_7036414.html) 

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Google image search in USA for “CEO” produced 11 % women, even though 27 % of United States chief executives are women.<sup>5</sup>

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# Ugly Results

Consider a loan application from a bank. Numerous attributes can be an input to a ML algorithm:

- Age
- Field of Work
- Income
- Gender
- Marital Status
- Residence District
- Number of Children
- Transaction History
- Race
- ...

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- **Gender !**
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- ...

Biases can be transferred through correlated attributes!



# Discrimination and Privacy-aware ML

Bias-free machine learning research should be encouraged.

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Importance of attributes inferred by the algorithm?

# Transparent Reporting

New ML algorithm predicts whether one has lung cancer or not with 90% accuracy.

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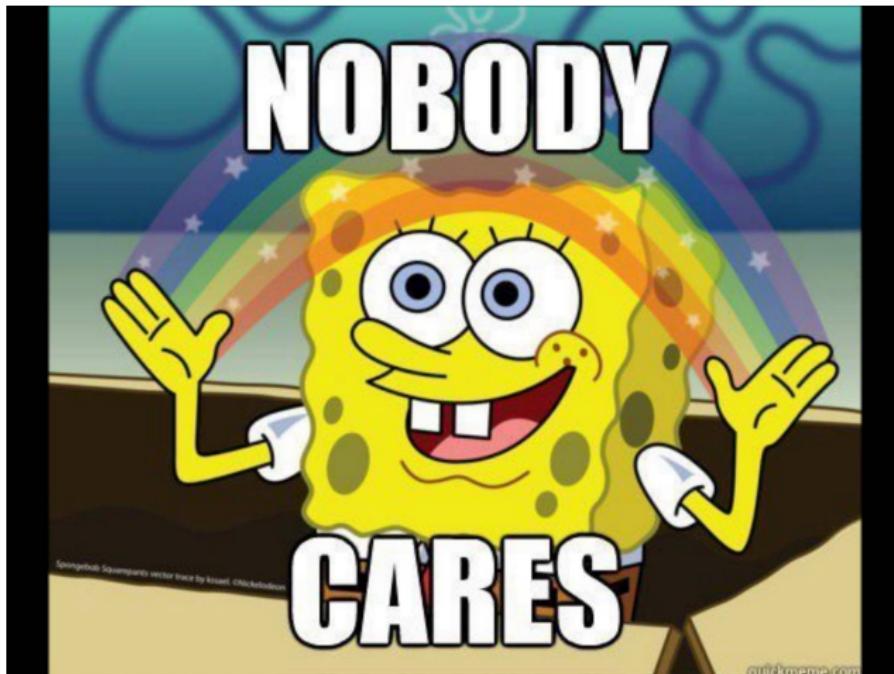
**Accuracies on different subgroups, false positive & true negative rates.**

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# Current State of Awareness

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## Current State of Awareness



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Black-box models (e.g. neural networks) are extremely popular!

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*“If it works, I don’t care why!”* approach.

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AI is coming (already here actually):

Deal with it!

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AI is coming (already here actually):

Deal with it!

Things will change:

Let's research on creating beneficial intelligence!

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